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Abstract

The protection of various tools and components through wear resistant coatings is imperative in highly efficient and precise industrial manufacturing processes. Especially, physical vapour deposited $Ti_{1-x}Al_xN$ and $Cr_{1-x}Al_xN$ coatings have been commonly used as hard protective coatings due to their outstanding thermal stability and mechanical strength. However, to increase the applicable working temperatures by simultaneously enhancing the wear performance (e.g., to allow for higher cutting speeds) further improvements are required.

Therefore, we studied in detail the impact of tungsten (W)—in combination with the substrate bias potential (U_{bias})—on the thermo-mechanical properties and wear performance of arc evaporated $Ti_{1-x-y}Al_xW_yN$ thin films. With increasing W content the quality of our coatings significantly increases due to pronounced reduction of growth defects (quantity of macro particles). All coatings studied crystallise in a supersaturated, single-phased face-centred cubic $Ti_{1-x-y}Al_xW_yN$ structure and their hardness (H) increases whereas the indentation modulus (E) decreases with increasing W content. This results in increased H^3/E^2 values, with a maximum of 0.19 GPa for $Ti_{0.50}Al_{0.41}W_{0.09}N$ prepared with U_{bias} = -120 V ($H \approx 35$ GPa, $E \approx 483$ GPa). All